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December 17, 2020

Via Electronic Filing

Marlene H. Dortch
Secretary
Federal Communications Commission
45 L Street NE
Washington, DC 20554

Re: ***In the Matter of Facilitating Shared Use in the 3100-3550 MHz Band (WT Docket No. 19-348); 3.5 GHz SAS and ESC Applications (GN Docket No. 15-319)***

Dear Ms. Dortch:

Numerous parties to this proceeding,[1] including Google,[2] have indicated strong support for development by the National Telecommunications and Information Administration (NTIA) of an automated, real-time, incumbent-informing spectrum sharing system (i.e., Incumbent Informing Capability, or IIC) to be operated with the Department of Defense (DoD). Such a system would notify authorized non-government users when they need to temporarily cease commercial operations in all or portions of the 3.45-3.55 GHz band (3.45 GHz band) to protect government operations. Many of these parties specifically note that an IIC would avoid spectrum waste that has become an unfortunate consequence of the Environmental Sensing Capability (ESC) framework currently deployed to protect DoD operations in the 3.55-3.65 GHz Citizens Broadband Radio Service (CBRS) range.[3] Indeed, in recently announcing an interagency

[1] *See, e.g.,* Comments of 5G Americas in WT Docket No. 19-348 at 14 (filed Nov. 20, 2020); Comments of CBRS Alliance in WT Docket No. 19-348 at 8-9 (filed Nov. 20, 2020) (*CBRS Alliance Comments*); Comments of CommScope, Inc. in WT Docket No. 19-348 at 12-13 (filed Nov. 20, 2020) (*CommScope Comments*); Comments of Nokia in WT Docket No. 19-348 at 6 (filed Nov. 20, 2020) (*Nokia Comments*); Comments of New America's Open Technology Institute and Public Knowledge in WT Docket No. 19-348 at 19 (filed Nov. 20, 2020); Comments of Sony Electronics Inc. in WT Docket No. 19-348 at 1-2 (filed Nov. 20, 2020) (*Sony Comments*); Comments of Wireless Innovation Forum in WT Docket No. 19-348 at 2-3 (filed Nov. 11, 2020) (*WInnForum Comments*); Comments of Wireless Internet Service Providers Association in WT Docket No. 19-348 at 23 (filed Nov. 20, 2020) (*WISPA Comments*); Reply Comments of Sony Electronics Inc. in WT Docket No. 19-348 at 1-2 (filed Dec. 7, 2020) (*Sony Reply Comments*); Reply Comments of Wireless Internet Service Providers Association in WT Docket No. 19-348 at 14 (filed Dec. 7, 2020) (*WISPA Reply Comments*).

[2] Comments of Google LLC in WT Docket No. 19-348 and GN Docket No. 15-319 at 11-12 (filed Nov. 20, 2020) (*Google Comments*).

[3] *See Sony Reply Comments* at 2 (noting that commenters broadly agree that the ESC mechanism's "deficiencies have led to unnecessary limits on commercial operations in the CBRS band and diminished spectral efficiency"); *WISPA Reply Comments* at 14 (explaining that "the ESC approach has proven to be

Government project focused on exploration of IIC, NTIA referred to IIC as a "promising innovation" that "could potentially securely and reliably expedite spectrum repurposing," as well as "permit easier and quicker spectrum access for commercial wireless services[, opening] the door to innovative, real-time automation."[4]

As the record demonstrates, adoption of IIC for the 3.45 GHz band as well as for CBRS would both mitigate the inefficient use of mid-band spectrum resources, and prevent potential conflicts between CBRS ESC sensors and 3.45 GHz band deployments in the adjacent band. This filing describes and illustrates the potential impact that CBRS ESC systems in 3.55-3.65 GHz could have on 3.45 GHz Service deployments and thereby underscores the need to transition to IIC in both CBRS and the 3.45 GHz band as expeditiously as possible.

Transitioning to IIC is Essential for More Efficient Spectrum Usage in Both the 3.45 GHz and CBRS Bands.

Today's ESCs listen for incumbent radar operations in the 3.55-3.65 GHz portion of the CBRS band and alert a Spectrum Access System (SAS) when such operations are detected, so that CBRS devices can be reconfigured in real time so as not to cause interference to the radars. The ESC framework has allowed CBRS operations to commence across the country, and it is a success in that sense. However, as Google's comments in this proceeding explain,[5] sustained use of ESC systems in CBRS and/or the 3.45 GHz band, as opposed to transitioning to IIC for both services, would require significant limitations on the use of the proposed 3.45 GHz band.

ESCs are already constraining spectrum use in the CBRS band. Industry standards and the Part 96 certification process require SASs to restrict deployment of CBRS devices that would interfere with ESCs' reception of incumbent radar signals.[6] The regions around ESC sensors in which CBRS operations are restricted are informally referred to as "whisper zones." CBRS deployments in 3550-3650 MHz (and up to 3680 MHz in some cases) are often severely limited within whisper zones to protect ESC sensors from interference.

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cumbersome and counterproductive to achieving efficient spectrum use"). *See also CBRS Alliance Comments* at 8 (describing the effects of "whisper zones"); *CommScope Comments* at 12-13 (explaining the effects of "whisper zones"); *Nokia Comments* at 6 (explaining limitations on spectrum when ESC sensors are down); *Sony Comments* at 2 (noting that "ESC-like sensor protection may result in static, substantially permanent restrictions"); *WInnForum Comments* at 2 (noting that overprotection of ESC sensors can constrain or eliminate "CBRS service for tens of millions of potential users"); *WISPA Comments* at 23 (explaining that the ESC approach can generate "false positives, disrupting communications").

[4] Charles Cooper, *NTIA Pursues Innovative Spectrum Sharing Plan That Could Deliver Boost to 5G*, National Telecommunications and Information Administration Blog (Dec. 15, 2020), https://www.ntia.doc.gov/blog/2020/ntia-pursues-innovative-spectrum-sharing-plan-could-deliver-boost-5g

[5] *Google Comments* at 11-12.

[6] *See, e.g.,* Wireless Innovation Forum, *Requirements for Commercial Operation in the U.S. 3550-3700 MHz Citizens Broadband Radio Service Band*, at 34 (Mar. 11, 2020), https://winnf.memberclicks.net/assets/CBRS/WINNF-TS-0112.pdf (*WInnForum Standards*); *Wireless Telecommunications Bureau and Office of Engineering and Technology Establish Procedure and Deadline for Filing Spectrum Access System (SAS) Administrator(s) and Environmental Sensing Capability (ESC) Operator(s) Applications*, Public Notice, 30 FCC Rcd. 14170, 14175 (2015).

ESCs can also constrain spectrum use in the adjacent 3.45 GHz band. While details on the permitted use of the 3.45 GHz band are not finalized, proposed EIRP limits are hundreds of times higher than in the CBRS band,[7] making potential interference to the CBRS ESC networks through adjacent-band interference probable. There is no guardband between the 3.45 GHz band and the ESC reception band beginning at 3.55 GHz. Therefore, it will be necessary to limit operations in the 3.45 GHz band to ensure that the sensitive detection mechanisms of the CBRS ESC sensors continue to protect Federal operations. Even if the final 3.45 GHz Service power limits are less than those proposed, the same whisper zone structure already implemented in CBRS to protect CBRS ESC sensors would have to be extended to the 3.45 GHz band as well, regardless of whether the new service itself uses an ESC-like approach or the proposed IIC. Extension of a CBRS-like ESC framework to the 3.45 GHz band would further constrain the 3.45 GHz Service by requiring the installation of new ESC sensors as well as increasing the range of frequencies that sensors monitor. All of these difficulties could be eliminated by transitioning the CBRS band from the ESC approach to IIC, while adopting the IIC approach for the new 3.45 GHz Service.

ESC Systems Could Block the 3.45 GHz Service in Large, Populous Geographic Areas

The following maps show the areas of the U.S. in which 3.45 GHz Service base stations may exceed the interference criterion for one or more currently-deployed CBRS ESC sensors. Deployments of 3.45 GHz Service base stations in these areas could be constrained when interference to CBRS ESC sensors and the resulting disruption to CBRS service are taken into account.

The maps are created using the following inputs for the red-shaded areas:[8]

- The ESC sensor interference criteria established by NTIA[9]
- The industry-standard propagation model used for ESC sensor protection[10]
- The industry standard for ESC sensor adjacent-band signal rejection[11]
- The characteristics of deployed ESC sensors from all currently-operating ESC networks
- The assumption that a 3.45 GHz Service base station is located outdoors at a height of 25 m above ground level, is pointed toward the ESC sensor, and is using the maximum allowed non-rural EIRP of 1640 W/MHz or, alternatively, a power level ten times below the maximum allowed value (i.e., 164 W/MHz)
- The highly-conservative assumption that only one 3.45 GHz Service base station, rather than multiple base stations with an aggregated effect, impacts any given ESC sensor

[7] CBRS is allowed a maximum EIRP of 5 W/MHz. *See* 47 C.F.R. § 96.41(b). The proposed maximum EIRP for the 3.45 GHz Service is 3280 W/MHz. *See In the Matter of Facilitating Shared Use in the 3100-3550 MHz Band*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd. 11078, Appendix D, proposed 47 C.F.R. § 27.50(k)(1) (2020).
[8] Additional details on creation of the maps are provided in Annex A.
[9] U.S. Department of Commerce, *Procedures for Laboratory Testing of Environmental Sensing Capability Sensor Devices*, at 3 (2017), *available at* https://www.its.bldrdoc.gov/publications/download/TM-18-527.pdf.
[10] *WInnForum Standards* at 11.
[11] *Id.* at 28.

The red-shaded areas are the computed whisper zones in which either a single 1640 W/MHz or a single 164 W/MHz 3.45 GHz Service base station is predicted to exceed the ESC interference threshold given the inputs above.

Note that these maps are based on current ESC deployments. More ESC networks are coming online,[12] and therefore the geographic area covered by whisper zones is likely to grow with time if the ESC framework is maintained.

[12] *See, e.g., Wireless Telecommunications Bureau and Office of Engineering and Technology Announce the Approval of an Additional Environmental Sensing Capability for the 3.5 GHz Band*, Public Notice, 35 FCC Rcd. 7001 (2020) (approving KeyBridge's ESC). *See also Wireless Telecommunications Bureau and Office of Engineering and Technology Establish "Second Wave" Deadline For Proposals From Prospective Spectrum Access System (SAS) Administrator(s) and Environmental Sensing Capability (ESC) Operator(s)*, Public Notice, 32 FCC Rcd. 2973 (2017).

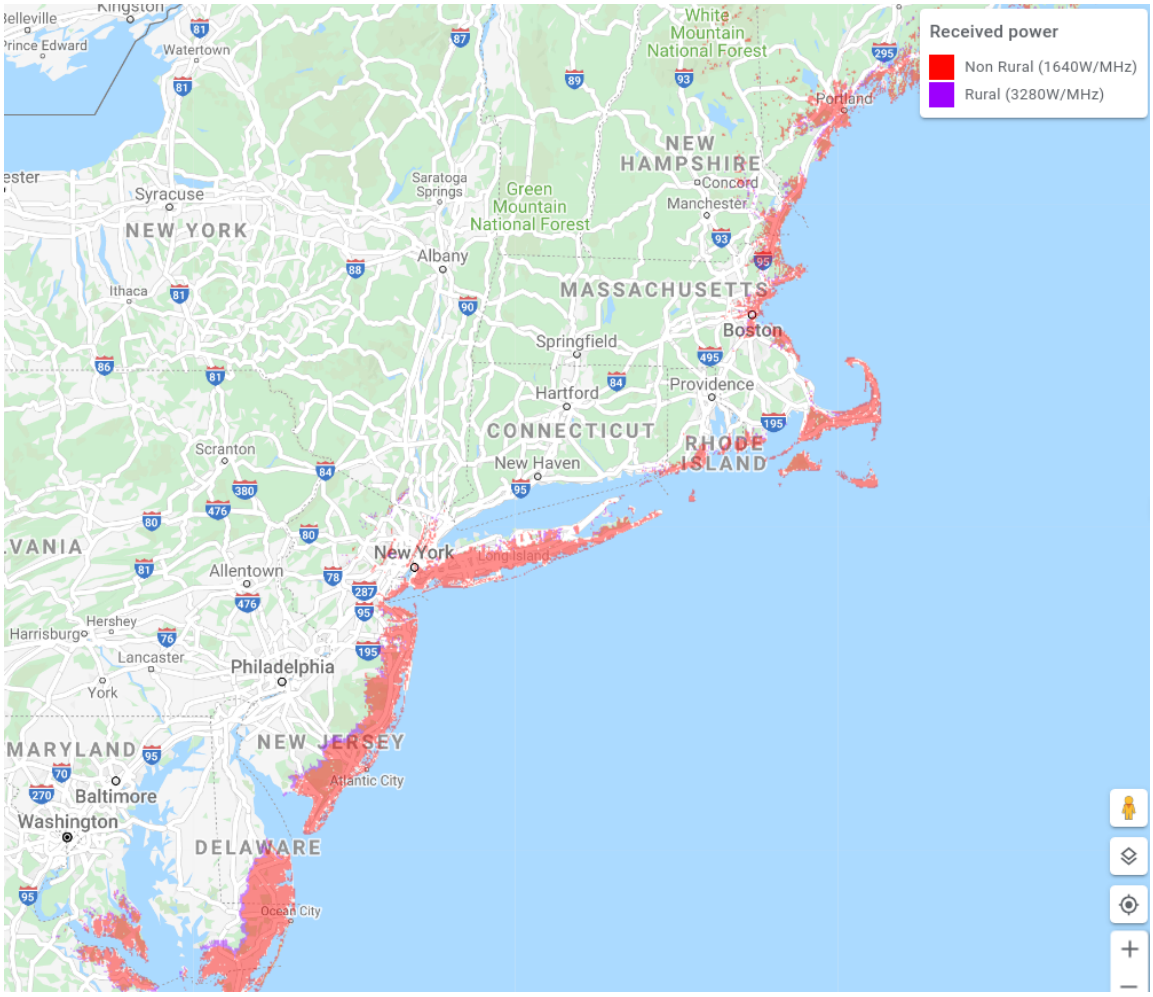

Figure 1(a): Regions (in red) along the northeast coast where placement of a single 1640 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

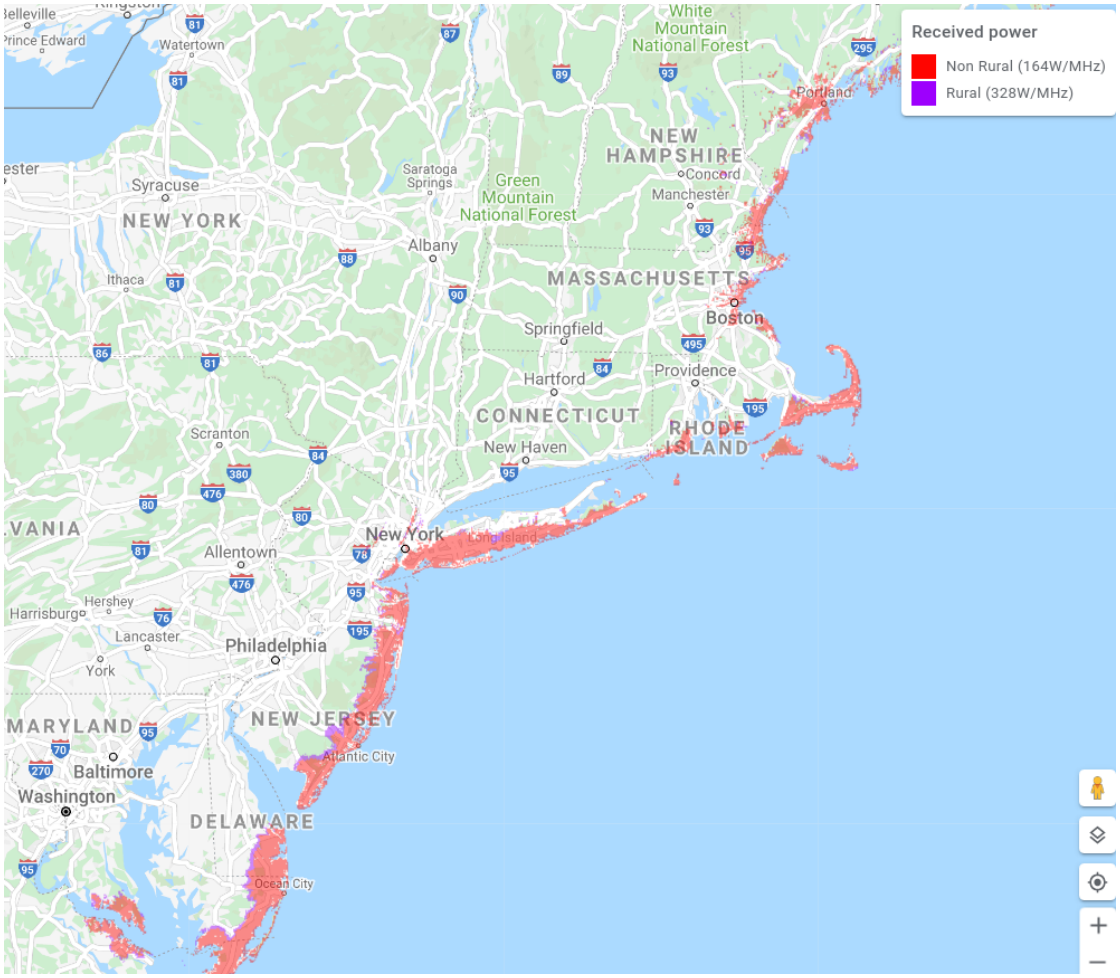

Figure 1(b): Regions (in red) along the northeast coast where placement of a single 164 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

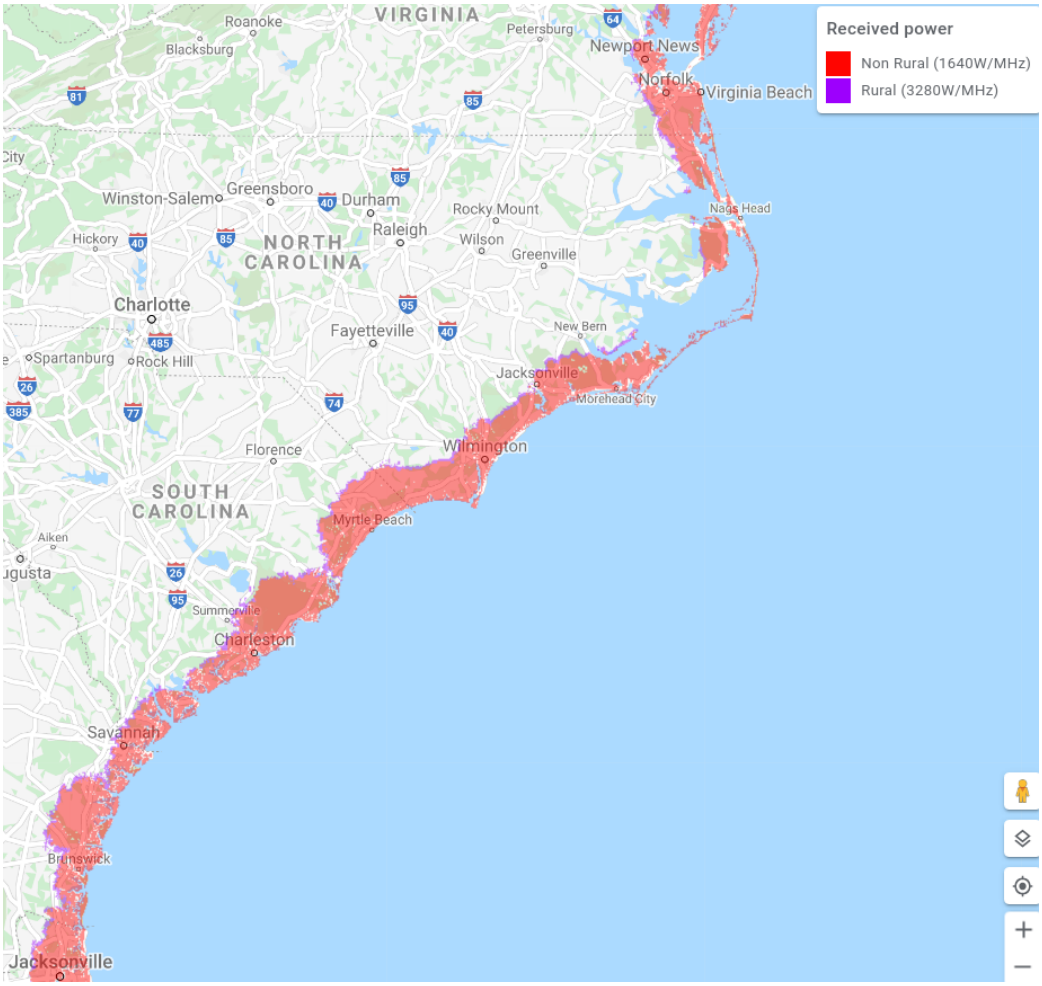

Figure 2(a): Regions (in red) along the mid-Atlantic coast where placement of a single 1640 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

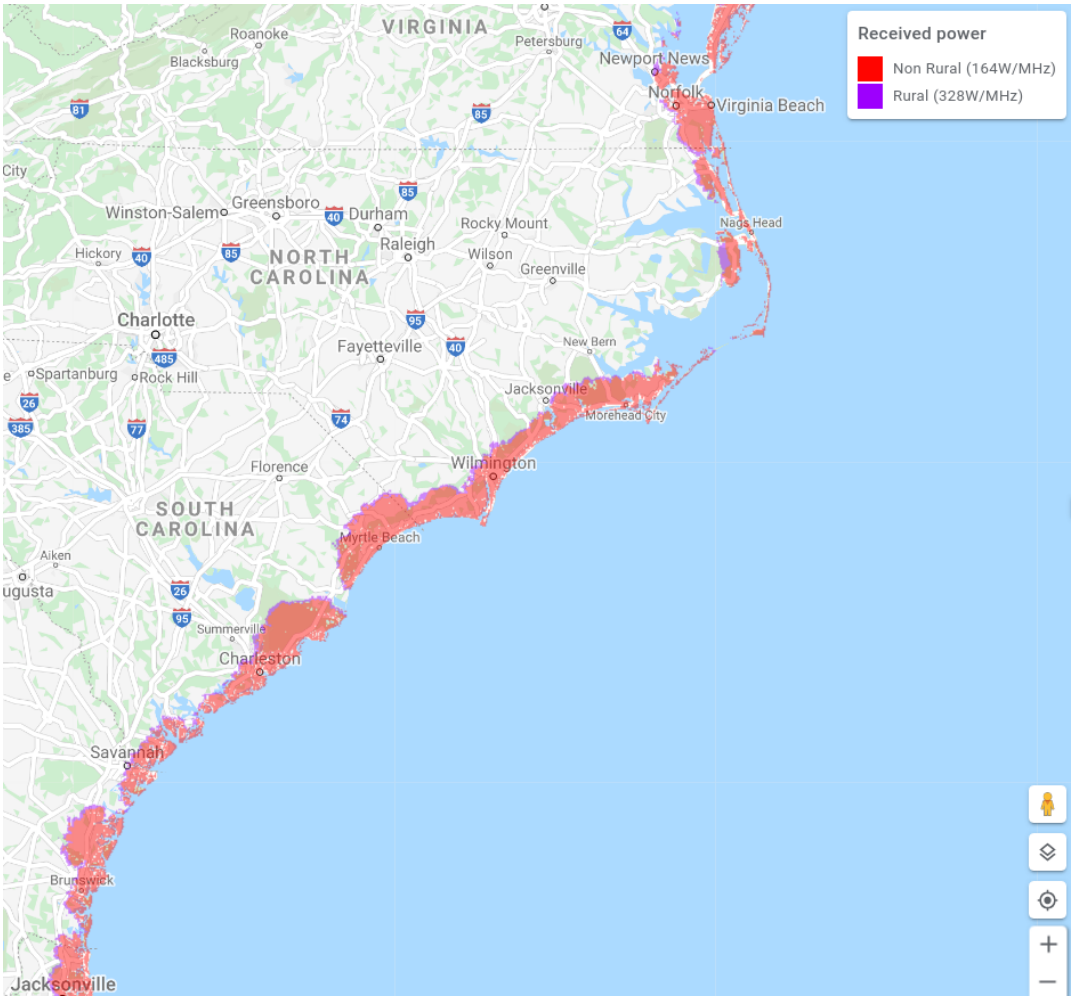

Figure 2(b): Regions (in red) along the mid-Atlantic coast where placement of a single 164 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

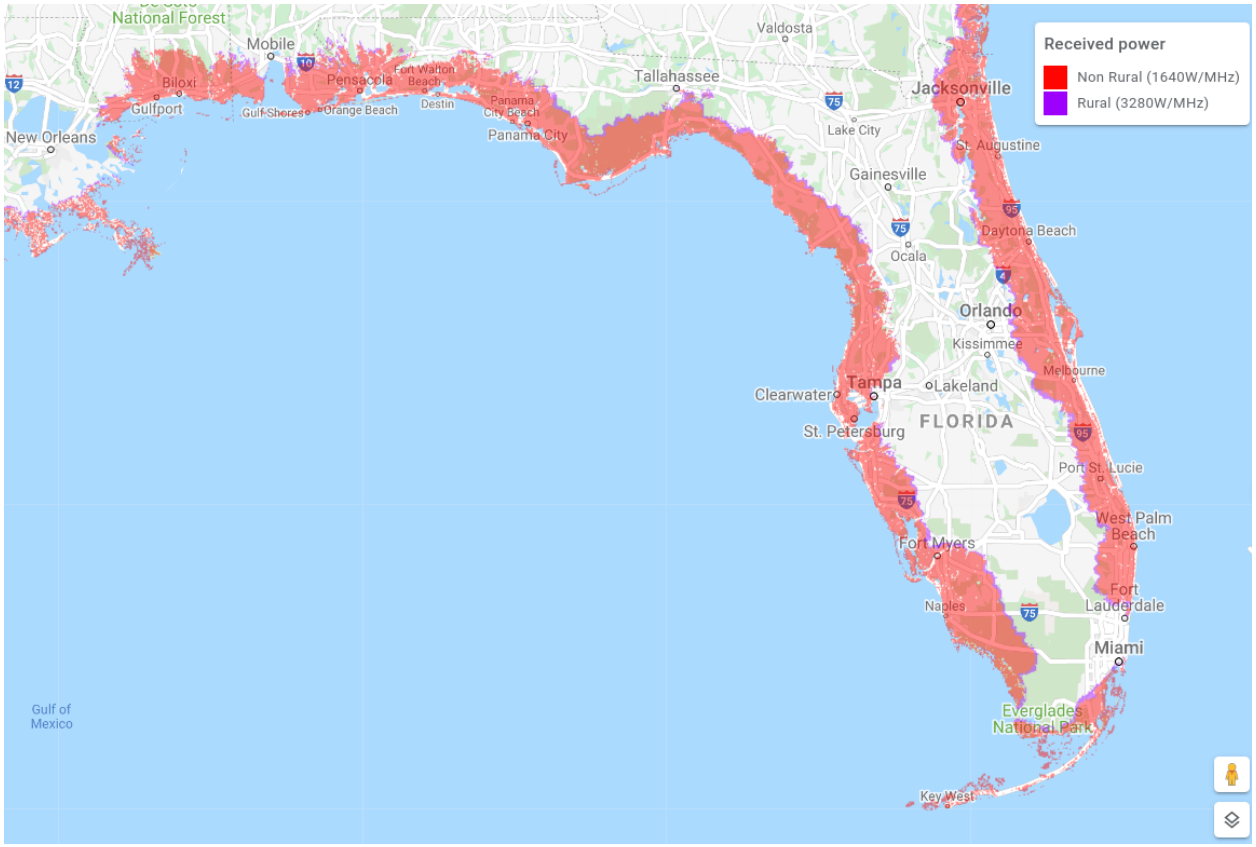

Figure 3(a): Regions (in red) along the Florida and Gulf coasts where placement of a single 1640 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

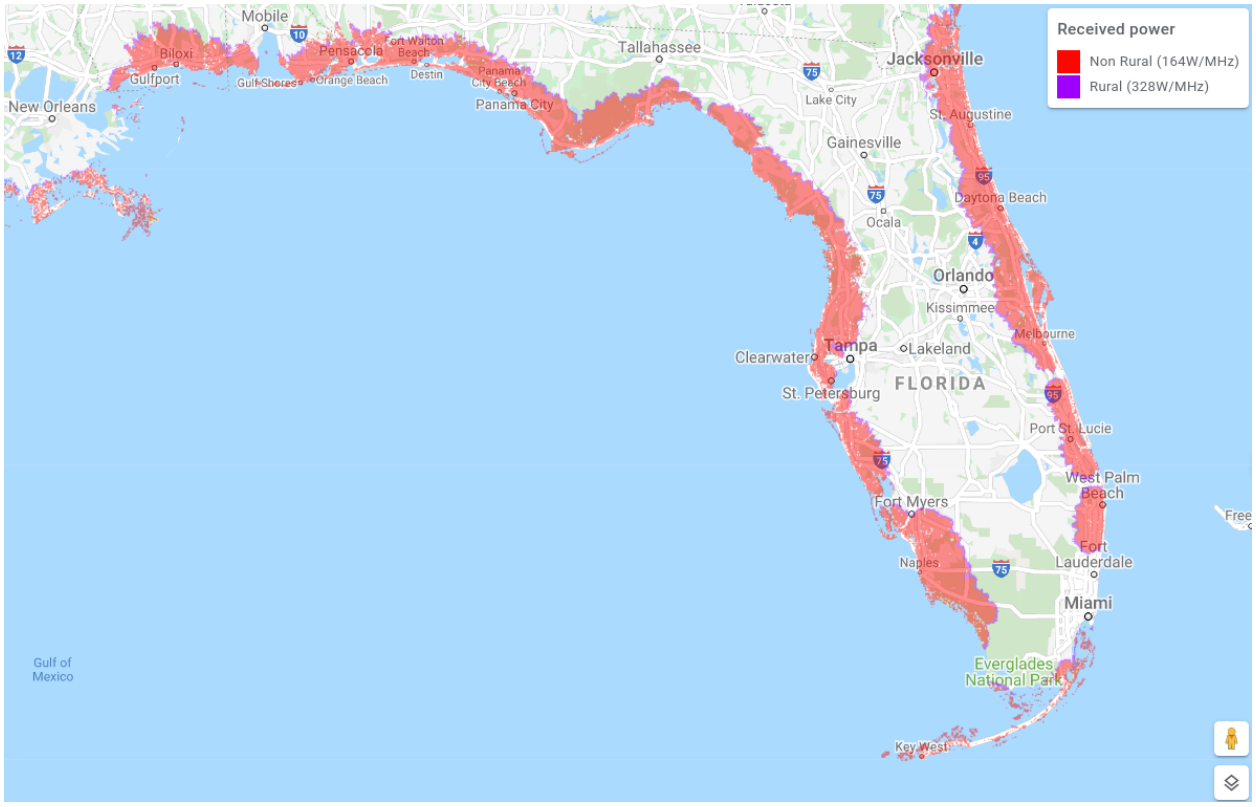

Figure 3(b): Regions (in red) along the Florida and Gulf coasts where placement of a single 164 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

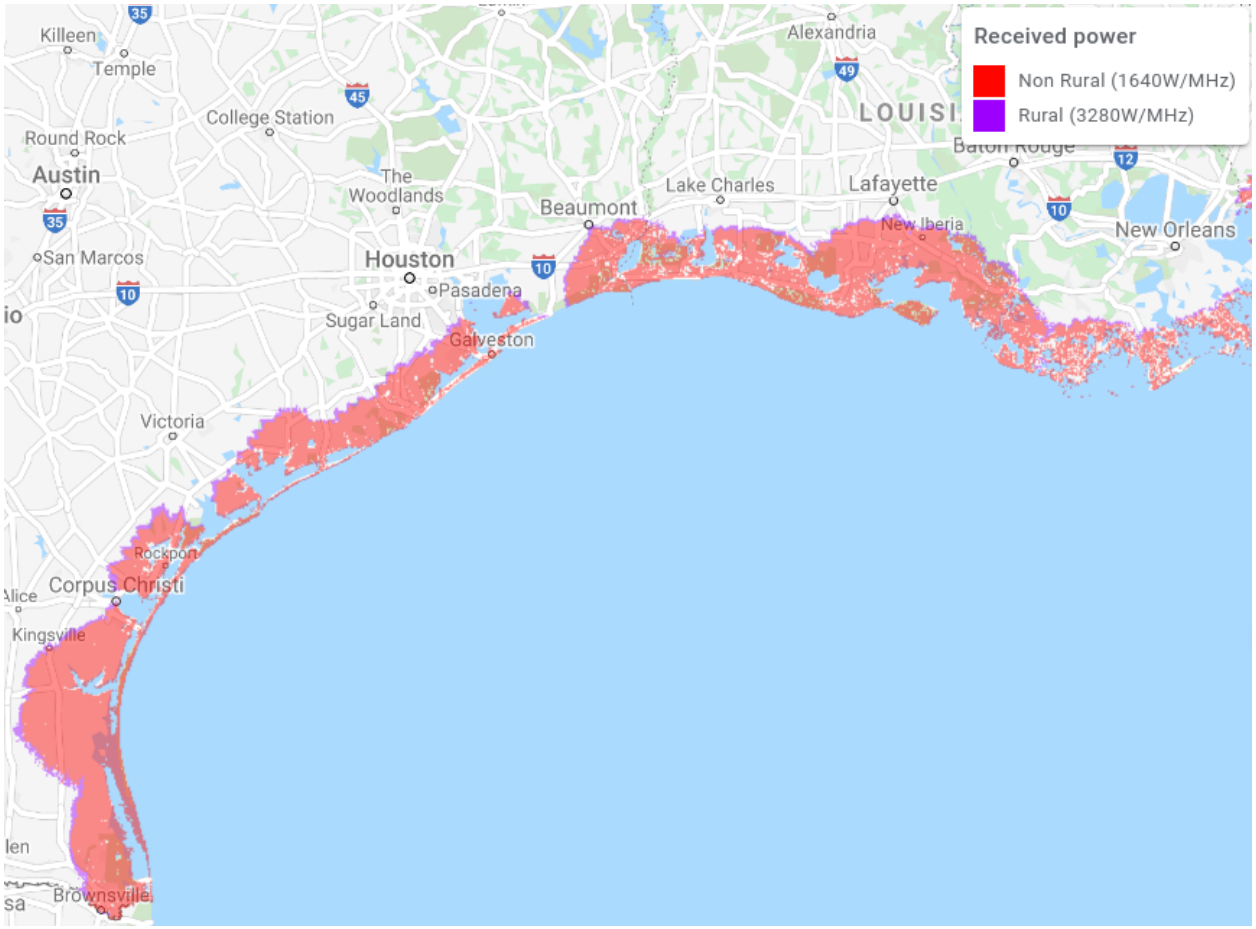

Figure 4(a): Regions (in red) along the Gulf and Texas coasts where placement of a single 1640 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

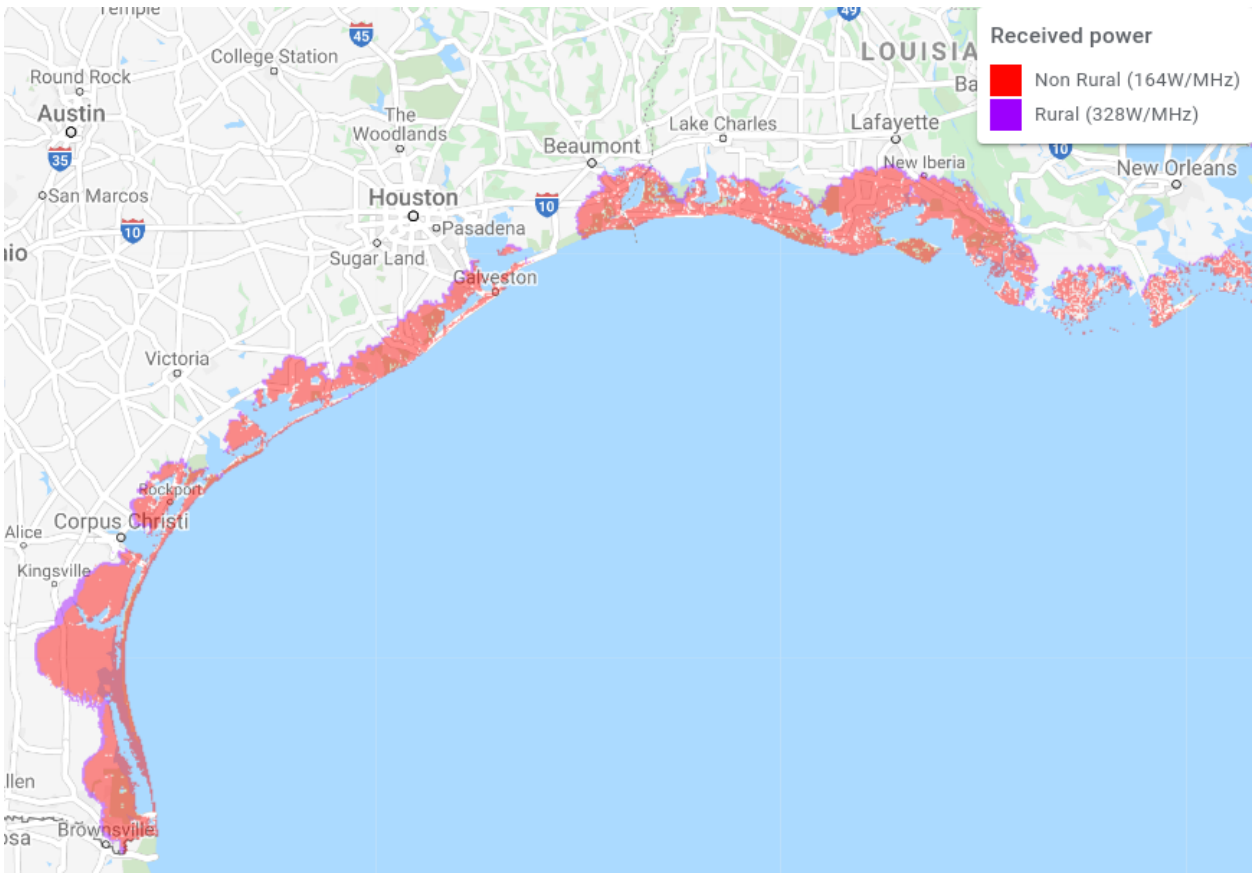

Figure 4(b): Regions (in red) along the Gulf and Texas coasts where placement of a single 164 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

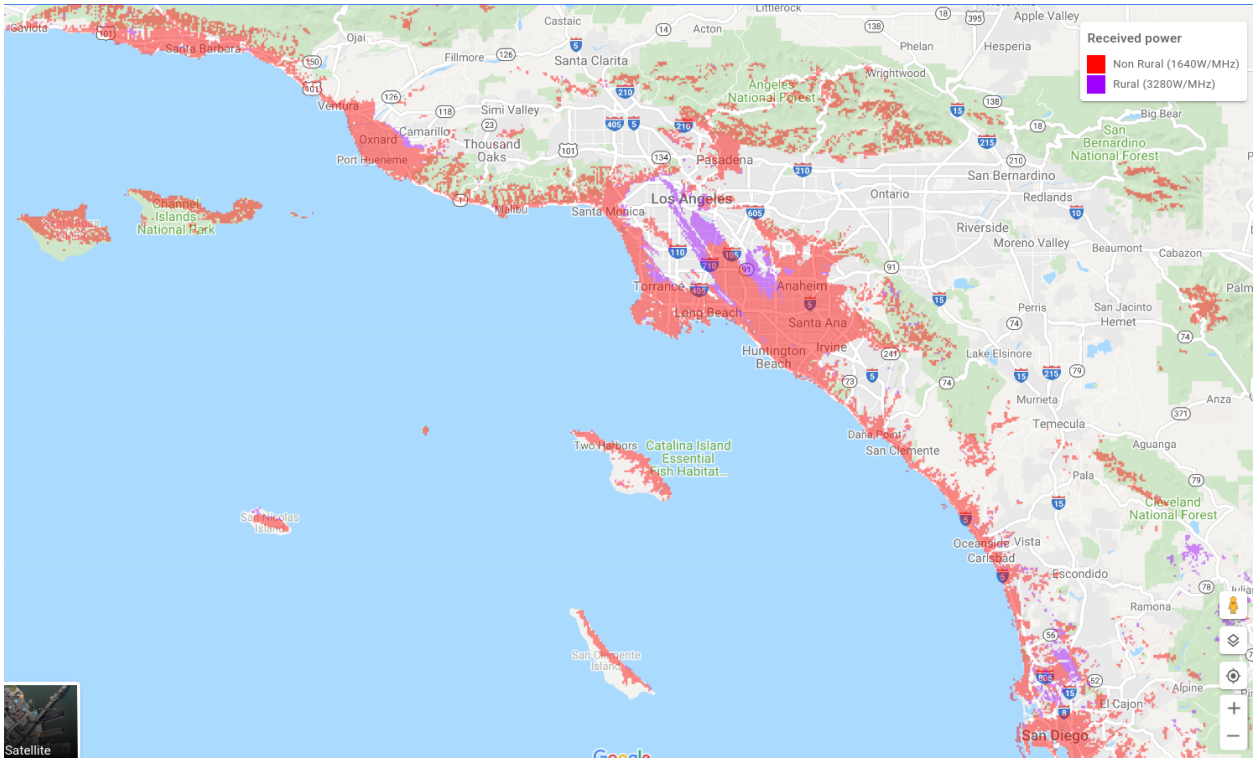

Figure 5(a): Regions (in red) along the southern California coast where placement of a single 1640 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

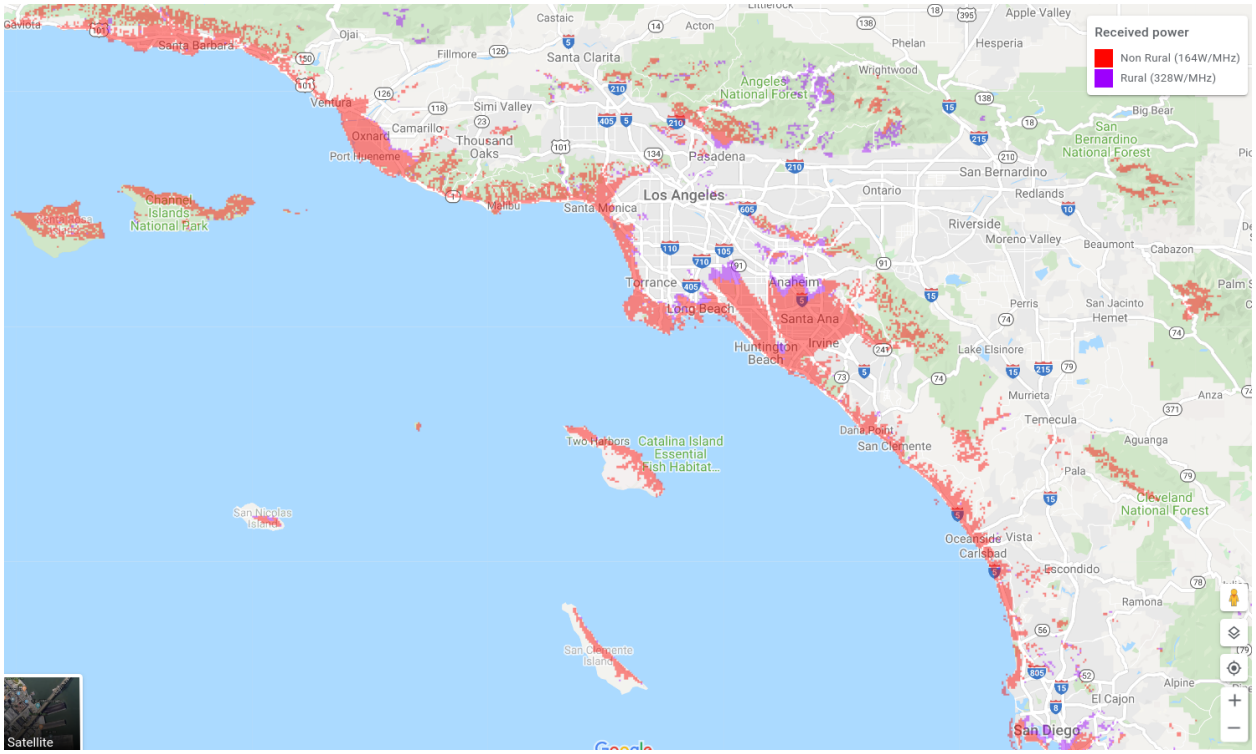

Figure 5(b): Regions (in red) along the southern California coast where placement of a single 164 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

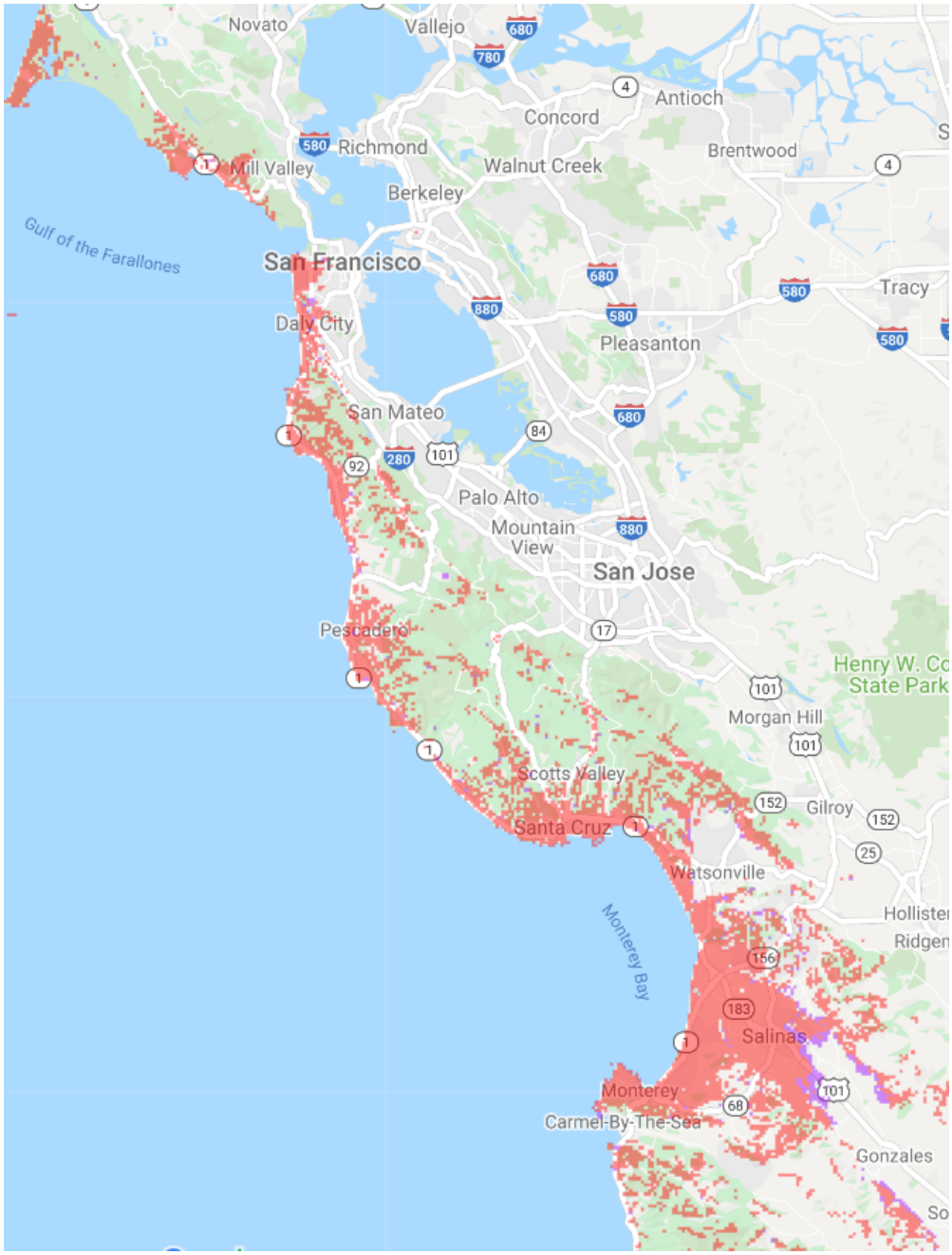

Figure 6(a): Regions (in red) along the northern California coast where placement of a single 1640 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

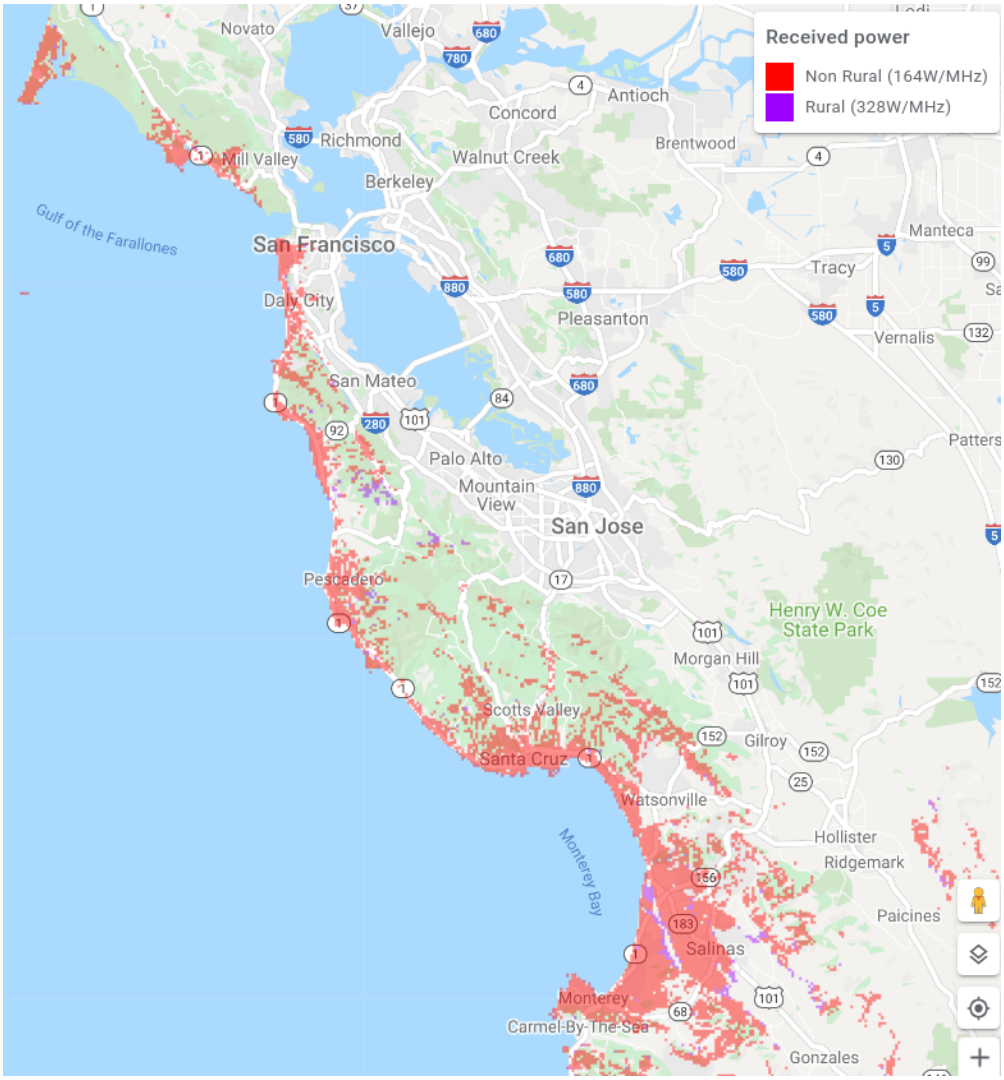

Figure 6(b): Regions (in red) along the northern California coast where placement of a single 164 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

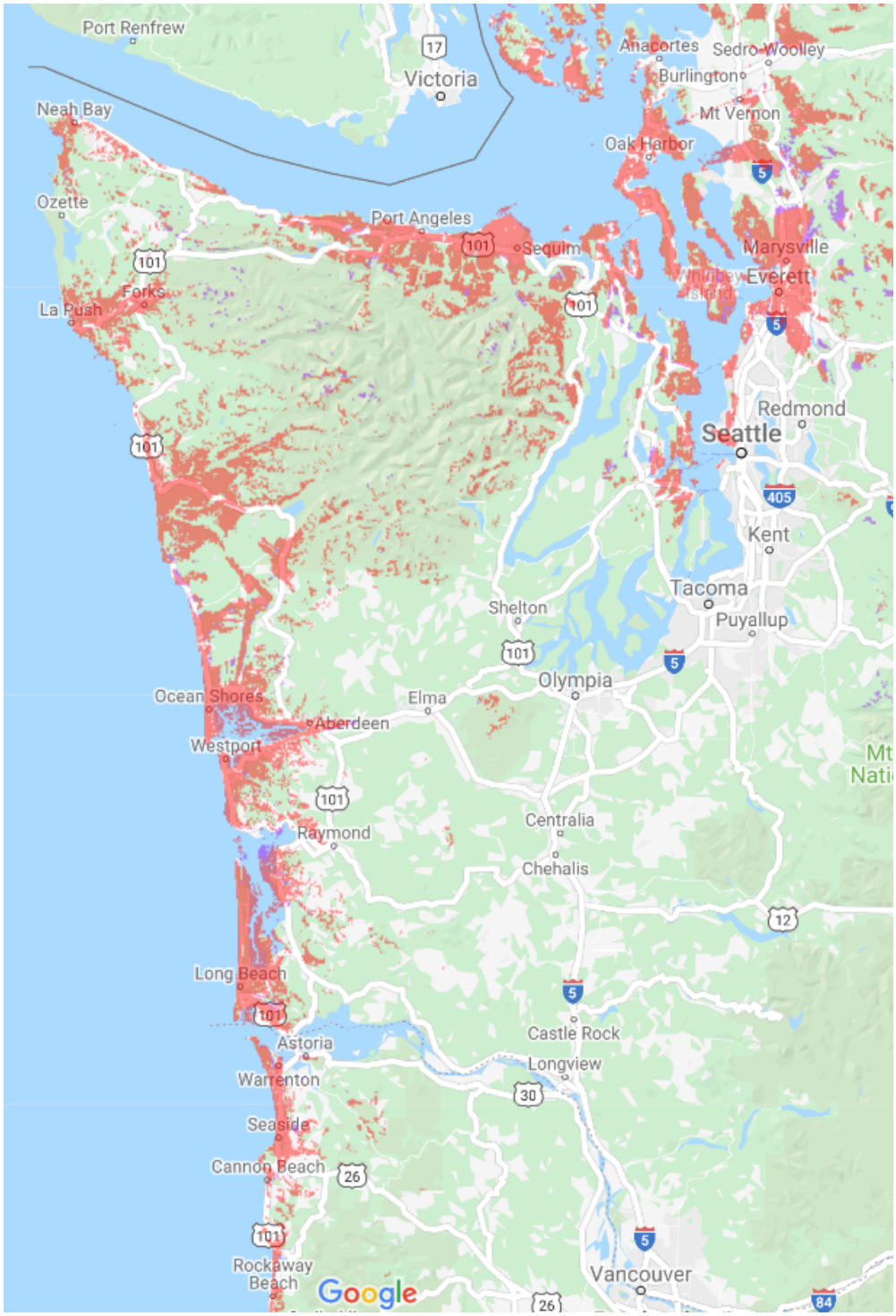

Figure 7(a): Regions (in red) along the Pacific Northwest coast where placement of a single 1640 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

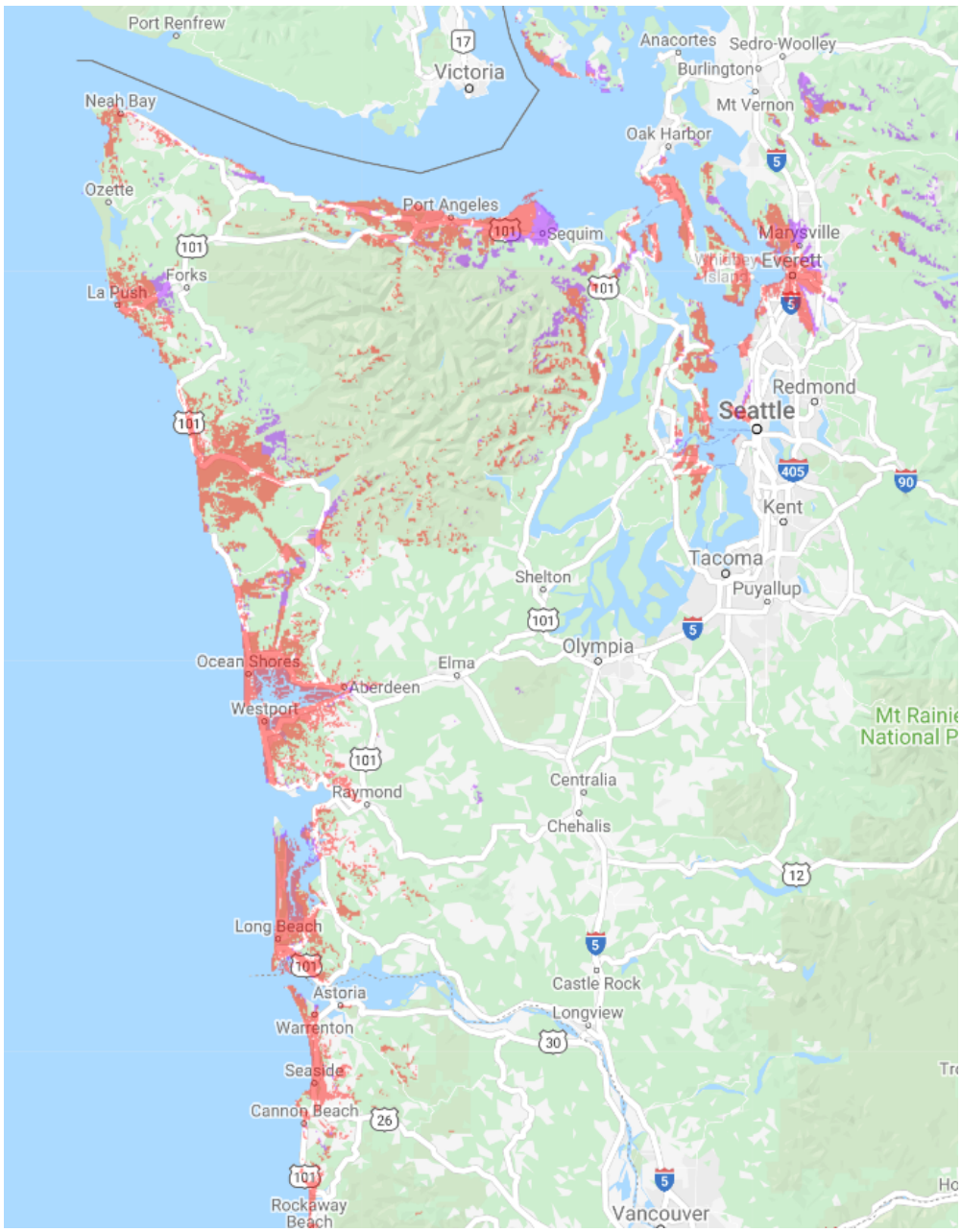

Figure 7(b): Regions (in red) along the Pacific Northwest coast where placement of a single 164 W/MHz EIRP 3.45 GHz Service base station could exceed the harmful interference threshold of one or more currently-deployed ESC sensors

CONCLUSION

To avoid interference to ESC sensors in the adjacent CBRS band and prevent substantial disruption to CBRS operations, the Commission will need to place considerable constraints on the siting and/or emissions of 3.45 GHz Service base stations. This would lower potential 3.45 GHz band auction revenues, suppress deployments in the band, and prevent the band from realizing its full public interest and economic potential. Adopting ESCs in the 3.45 GHz band would require even more extreme restrictions on the new service.

Use of IIC in both the 3.45 GHz and CBRS bands would eliminate these undesirable impacts. Therefore, in addition to mandating an IIC in the 3.45 GHz band, the Commission should commence a rulemaking to transition from the current ESC method of incumbent protection to an IIC system in the CBRS band.

Please do not hesitate to contact us with any questions about this submission.

Respectfully submitted,

Megan Anne Stull
Counsel

Andrew W. Clegg
Spectrum Engineering Lead
Google LLC

ANNEX A

How the Whisper Zone Maps are Created

The maps depicting whisper zones are generated using the following methodology:

1. The geographic area along the coastlines is divided into pixels of 0.5 x 0.5 km dimension.

2. For each pixel:

    a. A single 3.45 GHz Service base station, operating at either 1640 W/MHz or 164 W/MHz, is placed at the center of the pixel, with its antenna at a height of 25 m above ground level.

    b. Using the ITM propagation model, which has been adopted by industry for ESC protections,[13] the propagation loss from the base station to all currently-deployed ESC sensors within 120 km is computed. The ESC sensor's actual location, height, and antenna pattern are taken into account when calculating the total loss.

    c. If the base station's EIRP minus the total propagation loss from 2(b) and an adjacent band rejection factor (explained below) exceeds the NTIA-established[14] ESC protection criterion of -109 dBm/MHz for any of the ESC sensors, then the pixel is deemed to be in a whisper zone, and it is shaded red. If the interference criterion is not exceeded for any sensor, the pixel is not shaded.

    d. Repeat for each pixel.

Note that only one base station is considered in this analysis. Thus, the analysis is extremely conservative because it does not consider aggregate interference from more than one base station, from which actual ESC protections are derived.

The adjacent band rejection factor, used in step 2(c), is determined as follows:

- Based on the requirements in WInnForum standard TS-0112,[15] adjacent band interference to ESC sensors is computed similarly to co-channel interference, except the impact of an ESC receive filter is taken into account.

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[13] Wireless Innovation Forum, *Requirements for Commercial Operation in the U.S. 3550-3700 MHz Citizens Broadband Radio Service Band*, at 11 (Mar. 11, 2020), https://winnf.memberclicks.net/assets/CBRS/WINNF-TS-0112.pdf (*WInnForum Standards*).
[14] U.S. Department of Commerce, *Procedures for Laboratory Testing of Environmental Sensing Capability Sensor Devices*, at 3 (2017), *available at* https://www.its.bldrdoc.gov/publications/download/TM-18-527.pdf.
[15] *WInnForum Standards* at 28.

- Per the WInnForum standard, the ESC is assumed to have a filter that rolls off at a rate of 1 dB per MHz, from 0 dB at the ESC band edge to 30 dB at a frequency 30 MHz outside the ESC band. Interference beyond 30 MHz is not taken into account.
- By applying the filter in the linear domain to a uniform 30 MHz wide signal (3520-3550 MHz), and then converting back to log units, the filter reduces the signal by an overall amount of -8.9 dB.
    - Therefore a 1640 W/MHz (62.1 dBm/MHz) adjacent-band interferer has the same effect as a 211 W/MHz (53.2 dBm/MHz) in-band interferer.
    - A 164 W/MHz (52.1 dBm/MHz) interferer has the equivalent impact of a 21 W/MHz (43.2 dBm/MHz) in-band interferer.
    - These are, respectively, 16.2 and 6.2 dB greater than an in-band interferer operating at the maximum allowed 5 W/MHz (37 dBm/MHz) EIRP of a CBRS device.